

Food Color Chromatography Lab

AP Chemistry · Student Worksheet

Name: _____

Period: _____

Group: _____

Pre-Lab Questions

Complete before coming to lab. The retention factor compares how far a substance travels to how far the solvent travels:

$$R_f = \frac{\text{distance from baseline to center of spot}}{\text{distance from baseline to solvent front}}$$

1. In paper chromatography, identify the stationary phase and the mobile phase. What is the solvent front?

2. A chromatogram has a solvent front 8.0 cm above the baseline. Spot X is 2.4 cm above the baseline and Spot Y is 6.4 cm above the baseline. Calculate the R_f value of each spot.

Show your work

R_f of X: _____ R_f of Y: _____

3. Which spot in Question 2, X or Y, is more strongly attracted to the paper relative to the solvent? Explain.

4. Explain why the baseline is drawn in pencil instead of pen, and why the baseline must sit above the surface of the solvent.

5. FD&C Blue 1 has three charged sulfonate groups ($-\text{SO}_3^-$) and Red 40 has two. Predict which dye will travel farther in 2% NaCl solution and justify your prediction in terms of intermolecular forces.

Reference Table: FD&C Dye R_f Values

Values are approximate. Your R_f values may differ by about 0.1 because of paper, temperature, and how far the solvent travels.

Dye	Band color	R_f , 2% NaCl	R_f , 2% isopropyl alcohol
Red 40	Red	0.09	0.71
Yellow 6	Orange	0.2	not measured
Yellow 5	Yellow	0.26	0.92
Blue 1	Blue	0.73	0.94

Data Tables

Data Table 1: Food Colors in 2% NaCl

Solvent front distance (mm): R _____ B _____ Y _____

Food color	Band color	Strong or faint	Distance to band (mm)	R_f	Identified dye
Red					
Red					
Blue					
Blue					
Yellow					
Yellow					

Data Table 2: Solvent Comparison (Red Food Color)

Strip	Solvent	Solvent front (mm)	R_f , Red 40	R_f , Blue 1	Difference in R_f
R	2% NaCl				
RA	2% isopropyl alcohol				

Data Table 3: Mystery Sample in 2% NaCl

Sample letter: _____ Sample color: _____

Predicted food colors mixed: _____

Solvent front distance (mm): M _____

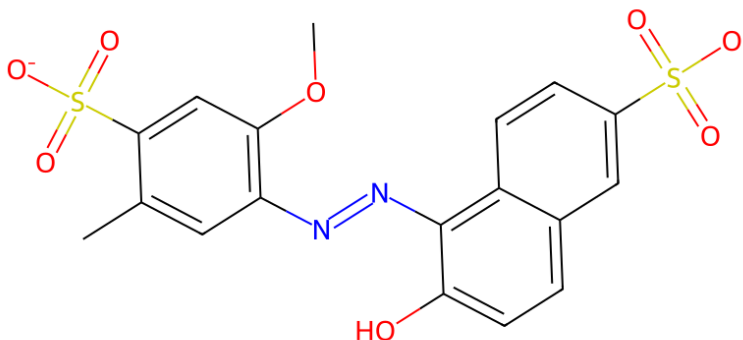
Band color	Strong or faint	Distance to band (mm)	R_f	Matching band (R, B, or Y strip)	Identified dye

Food colors mixed to make the sample: _____

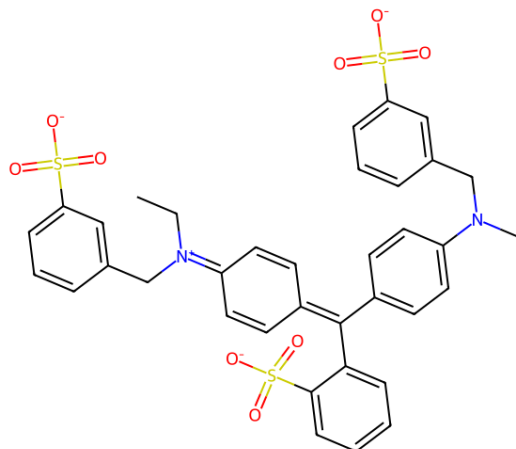
Structures and Intermolecular Forces

Use the structures below to explain how each dye interacts with the solvent and the paper. The dyes are shown as the ions they form in solution.

Red 40

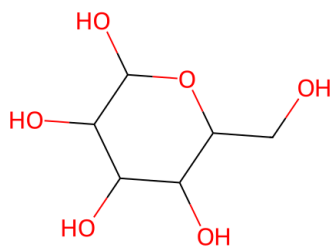


Blue 1



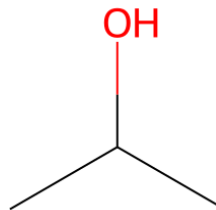
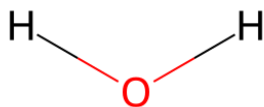
Cellulose (paper)

One glucose unit is shown. Cellulose is a long chain of these units, so the paper surface is lined with -OH groups.



Solvents

The 2% NaCl solvent is mostly water with dissolved Na^+ and Cl^- ions. The 2% isopropyl alcohol solvent is mostly water with dissolved isopropyl alcohol.



Water

Isopropyl alcohol

1. On the Red 40 and Blue 1 structures, circle and label each group that can interact with water, with Na^+ or Cl^- , or with cellulose. Look for sulfonate ($-\text{SO}_3^-$), $-\text{OH}$, $\text{N}=\text{N}$, and charged nitrogen groups. Then list the groups for each substance below.

Substance	Groups that can form IMFs
Red 40	
Blue 1	
Cellulose	
Water	
Isopropyl alcohol	

2. Complete the table with the strongest intermolecular force for each pair.

Dye	Strongest IMF with 2% NaCl	Strongest IMF with 2% isopropyl alcohol	Strongest IMF with cellulose
Red 40			
Blue 1			

3. Both dyes traveled farther in 2% isopropyl alcohol than in 2% NaCl. Use the structures of the dyes and of isopropyl alcohol to explain why.

Post-Lab Questions

1. List the dyes you found in each food color (red, blue, yellow). Which dye is the main component of each?

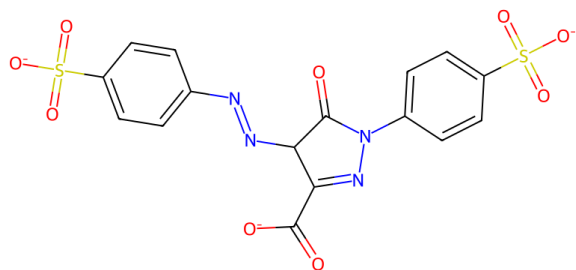
2. Which food color surprised you the most? Explain what you expected and what your chromatogram showed.

3. Using Data Table 2, which solvent separated Red 40 and Blue 1 better? Support your answer with the difference in their R_f values.

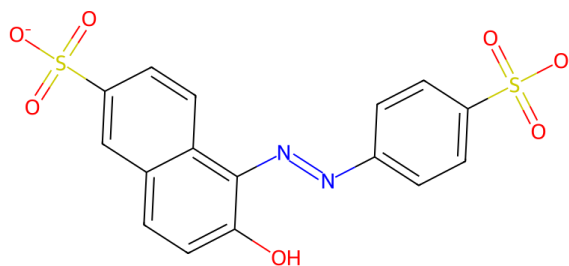
4. In 2% NaCl, Blue 1 traveled farther than Red 40. Which dye is more attracted to the solvent? Explain using intermolecular forces.

5. Did the yellow food color separate into two bands? Compare the Yellow 5 and Yellow 6 structures below. Explain why these two dyes are hard to separate, and predict which one should travel slightly farther in 2% NaCl. Does the Reference Table support your prediction?

Yellow 5



Yellow 6



6. Which food colors were mixed to make your mystery sample? Explain how the strong and faint bands support your answer.
